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## **Inequality in Mortality Decreased Among the Young While Increasing for Older Adults, 1990-2010**

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### **Abstract**

Many recent studies point to increasing inequality in mortality in the U.S. over the past twenty years. These studies often use mortality rates in middle and old age. Here we study inequality in mortality for all age groups in 1990, 2000, and 2010. Our analysis is based on groups of counties ranked by their poverty levels. Consistent with previous studies, we find increasing inequality in mortality at older ages. For children and young adults below age 20, however, we find strong mortality improvements that are most pronounced in poorer counties, implying a strong decrease in mortality inequality. These younger cohorts will form the future adult U.S. population, so this research suggests that inequality in old age mortality is likely to decline in future.

**Main text**  
*Introduction*

Poorer people tend to have shorter lives and are more likely to die than richer people at all ages. Understanding the evolution of these inequalities in mortality is a central concern of economists, policymakers, and the public. Not surprisingly then, a great deal of highly publicized research investigates changes in inequality in life expectancy and mortality in the U.S. over the past 20 years. A preponderance of the existing evidence points to alarming increases in inequality in mortality over this time period (1-16). Some studies investigating mortality trends across educational groups and geographic areas argue that not only is inequality in life expectancy widening, but that overall life expectancy is actually falling among the most disadvantaged groups (11-13).

However, much of the recent literature focuses on adults and in particular on life expectancy at age 40 or 50, exploiting rich data sets that link individuals' career earnings to deaths at older ages (1-8). By construction, these analyses omit children, teens, and young adults. A second strand of research analyzes demographic subgroups defined by education, location, and/or race (9-16). These studies typically focus on overall life expectancy at birth.

Life expectancy at birth is a summary measure that collapses all of the age-specific mortality rates observed in a given year (and in a certain demographic subgroup) into a single number. It provides information about how long a cohort of newborns can expect to live only under the assumption that the age-specific mortality rates observed in that given year remain constant into the future. This assumption is unlikely to hold in the U.S. given that mortality rates at all ages have been continuously changing (mostly improving) over the past century (17).

Changes in infant and childhood mortality have been shown to be important predictors of a cohort's health and mortality at later ages and hence may be more informative about the

development of future death rates for the current young. Moreover, mortality at young ages is considered a sensitive indicator of social conditions because it responds relatively quickly to changes affecting the entire population, compared to old-age mortality, which is partly determined by conditions in the past. The infant mortality rate has been shown to be an important indicator of health for whole populations and one that is highly correlated with more complex measures such as disability adjusted life expectancy (18).

Therefore, to study how inequality in mortality changes over time, it is important to understand age-specific mortality trends and in particular those at younger ages. Life expectancy at birth not only masks potential differences in age-specific trends, but the measure is also dominated by changes in old-age mortality because that is when most deaths occur. An important recent study by Case and Deaton (19) highlights the relevance of examining age-specific mortality rates: They document increases in middle-age mortality for non-Hispanic whites, a dramatic development that would not be detectable in overall life expectancy at birth.

### *Approach*

We follow an empirical approach based on placing counties into groups that allows us to analyze trends in age-specific mortality while taking into account population shifts across groups. We rank all counties in 1990, 2000, and 2010 by their poverty level and then divide them into 20 groups, each representing roughly 5% of the overall U.S. population (Fig. S1, Table S1). This way we can compare, for example, the 5% of the population living in the poorest counties in 1990 with the 5% of the population living in the richest counties in 1990, and analyze how the mortality differences between these groups change over time. In what follows, we will refer to the county groups with the highest (lowest) fractions of their populations in poverty as the

poorest (richest) counties. Our approach reassigns county groups in 1990, 2000, and 2010 to adjust for changes in county ranking and population size. That is, we compare the poorest counties representing a 20<sup>th</sup> of the population in 1990 with the poorest counties representing a 20<sup>th</sup> of the population in 2010, even if they are not exactly the same counties. The advantages of this procedure and a comparison with other approaches are discussed below. Our county grouping approach is similar to Singh and Siahpush (9) who investigate life expectancy trends ranking U.S. counties by a deprivation index (comprised of a set of county characteristics) up to 2001. Our approach differs from theirs in that they do not analyze age-specific mortality, they analyze data only up to 2001, and they do not reorder county groups over time.

### *Data*

Mortality rates are constructed at the levels of county group, gender, and age by dividing death counts from the U.S. Vital Statistics by population counts from the decennial Census. We focus on 3-year mortality rates for Census years 1990, 2000, and 2010, based on a total of 21,175,011 deaths. Life expectancy is calculated by constructing a life table based on 19 age groups (see the supplement for additional details regarding the construction of mortality rates and life expectancy). Socio-economic county characteristics including the poverty rate, median and per capita income, and the percent of high school dropouts, are taken from the Census in 1990 and 2000. For 2010 we use the 2008-2012 American Community Survey (ACS), which replaced the long-form of the Census for 2010. Table S1 reports socio-economic characteristics for the 20 county groups. The county group with the lowest fraction living in poverty has an average poverty rate of 3.75% and a median income (averaged across counties) of \$62,445 in 1990. The comparable 2010 figures are 5.58% in poverty and a \$62,752 median income. The

county group with the highest fraction living in poverty had a 30.47% poverty rate and a median income of \$23,595 in 1990. Comparable 2010 figures were 28.30% in poverty and a median income of \$25,404.

## *Results*

We start with the analysis of overall life expectancy at birth in order to make a better comparison with the strand of previous literature that has focused on this measure. Figure 1 (A) plots male and female life expectancies at birth for the 20 county groups in 1990, 2000, and 2010 (see Table S2 for numerical values and standard deviations). Standard deviations are within 0.1% of the estimates and 95% confidence intervals would be fully covered by the estimate markers if plotted in Figure 1 (A). In addition to the plotted life expectancy values, we have drawn a linear regression line through the 20 dots representing each year. For 2000, only the line (no symbols) is shown in order to reduce clutter. A steeper slope of the regression line indicates greater inequality in life expectancy. If there was no difference in life expectancy between richer and poorer county groups, then the line would be entirely flat.

Figure 1 (A) shows that for men, there is a strong gradient in 1990, with those living in the richest counties enjoying 6.10 additional years of life expectancy compared to those living in the poorest counties (74.79 vs. 68.70). For women, who have greater life expectancy overall, this gap is smaller at 3.01 years (80.20 vs. 77.19). Between 1990 and 2010, life expectancy at birth increased across the entire poverty spectrum, both for men and for women. For men, the fitted lines in 1990 and 2010 are almost parallel, suggesting that life expectancy increased by similar amounts in rich and poor counties. In fact, residents of the poorest counties gained slightly more with 4.63 additional years, compared to those in the richest county group, who gained 4.35 years.

For women on the other hand, improvements were stronger for those in the richest county group (3.01 vs. 2.06 years), and most of these improvements occurred between 2000 and 2010.

Figure 1 (B) plots the changes in life expectancy between 1990 and 2010. For women, the fitted regression line is downward-sloping ( $p=0.043$ ), indicating increasing inequality in life expectancy over this period. For men, the slope of the regression line is positive though not significantly different from zero ( $p=0.103$ ), consistent with Figure 1 (A)'s suggestion that decreases in mortality were equally distributed across men in rich and poor counties.

Turning to our key innovation--the analysis of age-specific mortality for all ages--Figures 2 and 3 show that the evolution of overall life expectancy at birth masks considerable heterogeneity in trends in mortality rates at different ages. Similar to Figure 1, each symbol in the figure represents the age-specific 3-year mortality rate in a bin representing 5% of the U.S. population, and the bins are ordered by county poverty rates. Mortality rates are plotted for 1990 and 2010 together with a linear regression line, while only the line is shown for 2000. Regression lines are upward sloping since mortality is higher in poorer counties, but, as in Figure 1, a flattening of the line over time indicates a decrease in inequality. Tables S3 and S4 report standard errors for the mortality rates and tests for a change in the slope of the fitted regression lines.

The first panel in Figure 2 shows the evolution of 3-year mortality rates for male newborns, which decreased by 4.2 per 1,000 in the group of richest counties between 1990 and 2010 (from 9.77 with 95% CI [9.10;10.44], to 5.53, with 95% CI [5.06;6.00]). Infant mortality in the group of poorest counties, however, decreased by 8.49 deaths per 1,000, which is more than twice as much over the same time period (from 18.28 with 95% CI [17.38;19.17] to 9.79 with 95% CI [9.22;10.37]). These strong reductions in mortality in the poorer county groups are

reflected in a considerable flattening of the regression line in 2010 compared to 1990. The slope of the regression line through the group values decreases by over 50%, and this change is highly significant ( $p < 0.001$ , Table S3). This flattening indicates a dramatic reduction in inequality in infant mortality.

A similar decline in mortality inequality can be observed up to age 20, though improvements for young children were greatest between 1990 and 2000, while for older children there were also large declines between 2000 and 2010. Looking at older ages, inequality decreased (i.e. the slope of the fitted regression line decreased significantly—see Table S3 for p-values) among males up to age 50. Between 50 and 75 there was no significant change in inequality in mortality, but after age 75, mortality inequality increased significantly among males. It is also striking that for adult men between 20 and 34 there was virtually no improvement in mortality rates between 2000 and 2010.

Figure 3 shows that the patterns are somewhat different for females. As it did for males, female mortality decreased strongly for age groups up to age 19, and these improvements were significantly stronger in the poorest counties, implying that inequality in mortality decreased dramatically (see Table S4 for p-values of the differences in the slopes). However, while inequality decreased significantly for males until age 50, this trend is observed for females only up to age 30. For ages 30 to 45, there is no significant change in mortality inequality, while for all age groups over 45 inequality in mortality increases.

Turning to the mortality rates themselves, it is striking that, as was the case for males, there was practically no improvement in mortality among women aged 30 to 45 between 1990 and 2010. This is a truly remarkable development in light of the significant progress made in other age categories. A further remarkable fact is that mortality rates actually increased in some



of the richest counties among females aged 20 to 29. After age 45, there are mortality declines, but they are larger in the richer county groups, driving the increase in mortality inequality noted above.

The results discussed so far are all based on ranking counties by poverty rates, which is arguably the most relevant measure if one is focusing on differences between the rich and poor. However, there are several additional measures of socioeconomic status available at the county-level. The age-specific trends in mortality are very similar when ranking counties by these alternative measures, including the share of high school drop-outs, median income, or average life expectancy (Fig. S2-S4).

### *Discussion and Conclusions*

In contrast to many recent analyses of inequality in mortality that focus on life expectancy at middle age, we find overall improvements in life expectancy at birth both in counties with high poverty rates and counties with low poverty rates. However, we argue that life expectancy measures are not (despite their name) intended to be predictive of the number of future years of life that any particular cohort can expect to attain and that it is more informative to examine age-specific mortality rates. Our analysis of these rates indicates that inequality in mortality between rich and poor counties has strongly declined among infants, children and young adults up to age 30 of either gender as well as among adult males up to age 50. Among older adults, mortality has continued to decline, though declines are generally greatest in the richest counties, indicating increasing inequality in mortality, which is in line with the literature that has focused on inequality trends at older ages (1-8).

Our focus on using county groups to examine inequality has advantages and disadvantages. Unlike subgroups defined by race and education or by individual counties, county groups are large enough to provide precise mortality estimates in age ranges with low mortality. Moreover, the county of residence is consistently reported both in the Vital Statistics and the Census data, which makes mortality rates by county group subject to less measurement error than using other demographic groups that can be constructed with these data sets. For example, education is often missing from death certificates, and education measures were switched from years of schooling to degrees for some states in the mortality files but not in the Census. Even race is not always consistently reported. For example, the Census introduced multiple race categories in 2000 while the Vital Statistics reports permit identifying as only one race. These changes in the reporting of race and education introduce a fundamental bias, since they impact the numerator and the denominator of a subgroup's mortality rate differently. And since these biases change over time, they confound the estimation of trends in inequality.

Changes in the composition of the analyzed demographic subgroups present another serious source of bias (20-23). For example, Olshansky et al. (13) document decreasing life expectancy among non-Hispanic white women without a high school degree between 1990 and 2008. But the share of the population of white non-Hispanic females in this education category fell by about two-thirds between 1990 and 2010, which suggests that the average female high school dropout today is much more disadvantaged relative to her peers than the average female high school dropout in 1990. Bound et al. (20) argue that there is in fact no decrease in life expectancy for the least educated once these compositional changes are accounted for. Similarly, single counties that experienced declining life expectancy (11-12) tend to be poor places that have lost population over the past 20 years. If the healthiest people leave, then the ones who

remain will be less healthy on average, biasing the estimated changes in mortality inequality. Our approach accounts for potential compositional changes by reordering county groups so that they represent constant shares of the population over time. In the context of county groups, however, such compositional changes do not seem to play a crucial role as our results look very similar when we keep the county groups assigned in 1990 fixed and follow them up to 2010 (Fig. S6).

One limitation of our approach is that it necessarily focuses on differences between groups of counties, whereas much of the increase in, for example, individual income inequality, may be occurring within counties. However, by its nature, mortality must be calculated relative to some reference group. Using county groups as the reference allows one to cleanly answer questions about inequality between these groups in a way that may just not be possible with respect to other reference groups, such as education.

What are potential causes for the different age-specific trends that we observe? Aizer and Currie (24) highlight many possible reasons for dramatic reductions in infant mortality among the poor, which have reduced inequality in mortality among infants. We are not aware of any research that has looked at the causes of reductions in mortality inequality among older children and young adult males. Some possibilities include expansions of public health insurance (25-29), other social safety net programs such as Head Start (30, 31), and reductions in pollution, which tend to have disproportionate effects on the poor (32).

Among older adults, it is likely that at least some of the increasing disparities in mortality reflect differential patterns of both taking up and quitting smoking over their life-cycles. Better educated people stopped smoking much more quickly following the 1964 Surgeon General's report on the dangers of smoking, for example (33, 34). Improvements in medical care for conditions such as heart disease also tend to benefit the rich before they reach the poor. The

outbreak of the opioid epidemic is another factor that may be driving increased mortality inequality and actual increases in mortality rates in middle age (19). As Case and Deaton (19) show, it may be possible to get some insight into these questions by studying the causes of death in the Vital Statistics mortality data, though changes in measurement, measurement error, and missing data about causes mean that these data have to be interpreted cautiously.

Our results point to decreasing inequality in mortality, particularly among the younger cohorts who will form the future adult and elderly population of the United States. It is possible that survivors who would otherwise have died will be in poor health as they age and thus reduce the average level of health in the population. However, another possibility is that the declines in mortality at younger ages reflect improvements in the entire underlying distribution of health (35). In at least one important example, the case of expansions of public health insurance for poor infants and young children in the late 1980s and early 1990s, the reduced early death rates in these cohorts are associated with better health (27-29) and higher earnings (25) as these cohorts reach young adulthood. Thus there appears good reason to hope that today's young will also be healthier when they reach old age and that inequality in mortality will decrease among these elderly in the future.

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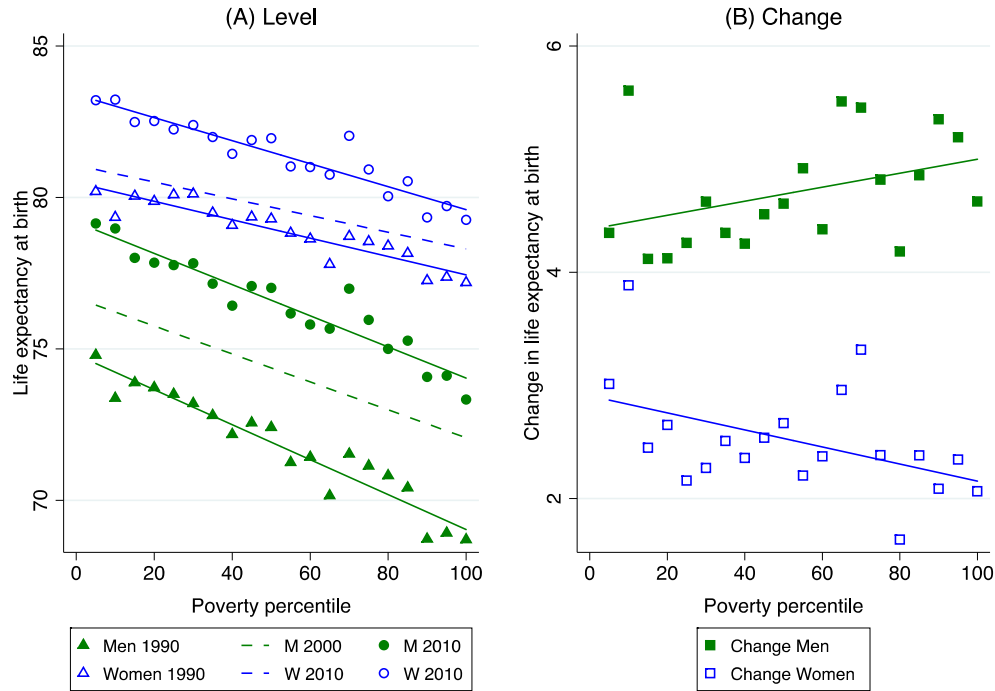
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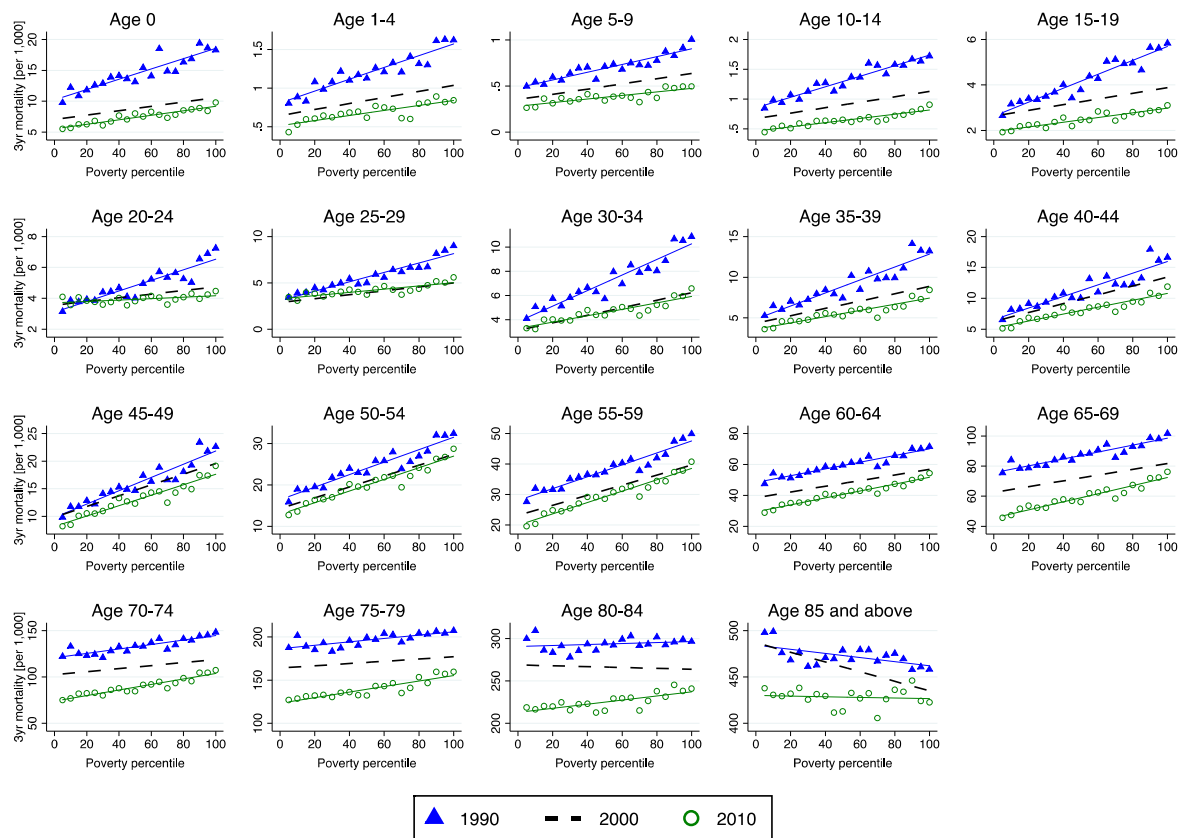
**Figure 1: Life expectancy at birth by poverty percentile and gender**



Caption: **(A)** Average male and female life expectancy at birth by poverty percentile. Each bin represents a group of counties with about 5% of the overall population, respectively. The solid lines provide the fitted regression lines. Higher percentiles refer to higher poverty levels. A steeper slope implies greater inequality in life expectancy at birth. Magnitudes reported in Table S2. **(B)** Changes in average male and female life expectancy at birth by poverty percentile. The fitted regression line has a slope of 0.0062 ( $p=0.103$ ) for men and a slope of -0.0075 ( $p=0.043$ ) for women.

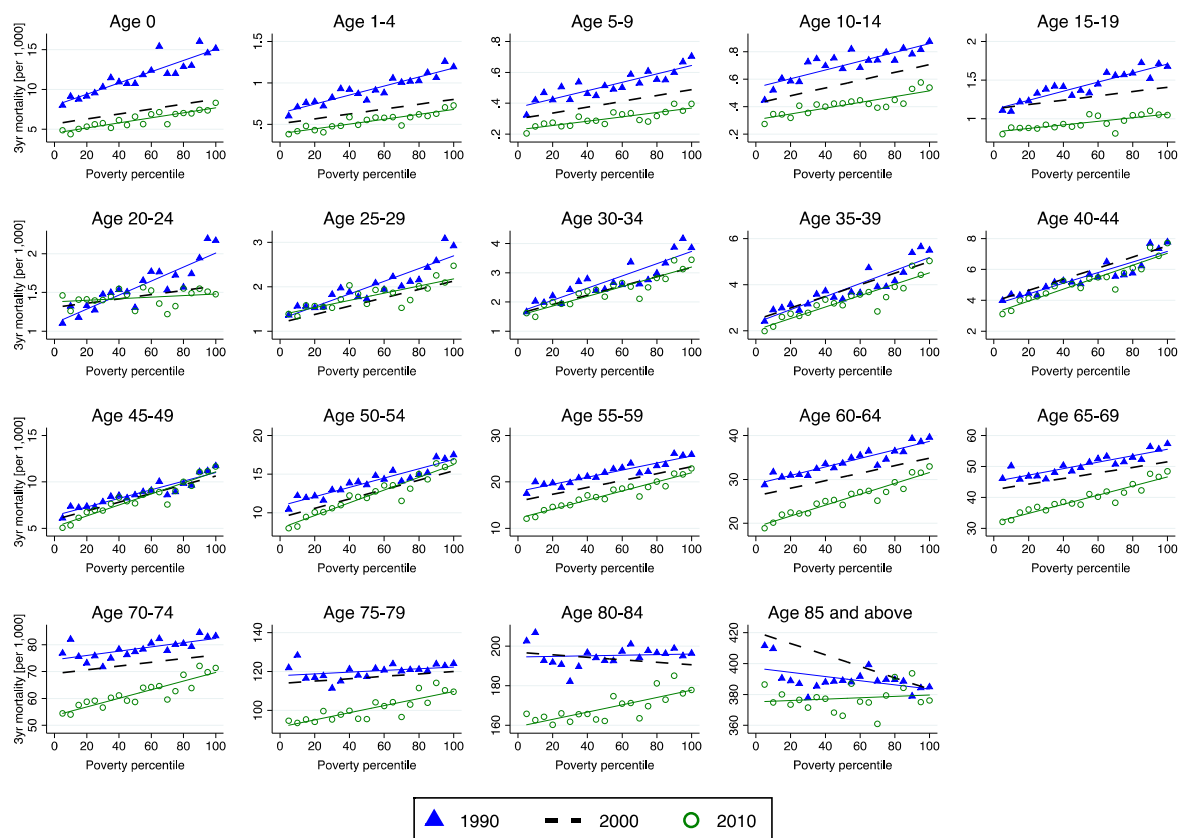


**Figure 2: Male 3-year mortality rates by poverty percentile across age groups**



Notes: Average 3-year mortality rates are plotted across poverty rate percentiles. Each bin represents a group of counties with about 5% of the overall population in the respective year. Straight lines provide linear fits. Table S3 reports key magnitudes and standard errors.

**Figure 3: Female 3-year mortality rates by poverty percentile across age groups**



Notes: For explanations see notes below Figure 2. Table S4 reports key magnitudes and standard errors.

# Supplementary Materials for

## Inequality in Mortality Between Rich and Poor U.S. Counties Decreased Among the Young While Increasing for Older Adults, 1990-2010

These supplementary materials include:

Materials and Methods

Figs. S1-S8

Tables S1-S4

# Supplementary Materials and Methods

## *Mortality rates*

Mortality rates equal the number of deaths divided by the size of the population, and we report the rate per 1,000 people. We construct age, gender, and race-specific 3-year mortality rates at the level of county groups for the years 1990, 2000, and 2010 based on the universe of deaths in the U.S. (provided by Vital Statistics, [http://www.cdc.gov/nchs/data\\_access/vitalstatsonline.htm](http://www.cdc.gov/nchs/data_access/vitalstatsonline.htm)) and the 100% population counts from the decennial Census (<http://www.socialexplorer.com/>).

Geographical identifiers are restricted in the public use Vital Statistics mortality data, in order to avoid potential identification of individual deaths in the micro data. We therefore do not post mortality data at the county level. However, we provide mortality and life expectancy data at the level of 20 county groups, which can be used to replicate all of our results.

The mortality data gives the month of death, which allows us to construct mortality rates based on deaths that occurred after the Census Day (April 1<sup>st</sup>). For example, the 3-year mortality rate at age 0 in 1990 is the sum of all deaths among 0-year olds between 4/1990-3/1991, 1-year olds between 4/1991-3/1992, and 2-year olds between 4/1992-3/1994, divided by the population of 0-year olds in the 1990 Census. Results are robust to using 1-year mortality rates instead or 3-year mortality rates. The standard deviation of a mortality rate can be computed as the square root of  $(d*(1-d))/Pop$ , where  $d$  is the mortality rate (with  $0 \leq d \leq 1$ ) and  $Pop$  the population size. Given that the population in each county group/age/gender/year bin is fairly large, standard errors are small (see Tables S3 and S4).

We use the decedent's county of residence rather than the county where the death occurred, as the Census reports the county of residence instead of the county in which a person is

located on Census Day. Following Dorn (36) we account for changes in county definitions that occurred between 1990 and 2010.

### ***Life expectancy data***

Life expectancy at birth is a summary measure of the mortality rates at all ages in a given year, and it equals the number of years a hypothetical cohort could expect to live if it experienced exactly these age-specific mortality rates throughout its life. Life expectancy is not informative about how many years any actual current or future cohort can expect to live.

We construct life expectancy based on 1-year mortality rates at the level of county groups, gender, and 19 age groups (<1, 1-4, 5-9, ..., 80-84, <84) for the years 1990, 2000, and 2010. For the construction of life expectancy based on age groups, see for example Chiang (37). Due to the large number of people in each county group/gender/year bin, confidence intervals around our life expectancy estimates are small (see Table S2).

The Institute for Health Metrics and Evaluation (IHME 38) provides life expectancy estimates for the years 1990, 2000, and 2010 at the level of individual counties, which are estimated taking into account county-specific time trends, mortality rates in neighboring counties, and time-varying county characteristics. As Fig. S5 shows, using the IHME (38) life expectancy estimates, aggregated to county groups, instead of our own estimates results in a very similar pattern.

### ***Defining changes in inequality in mortality***

We analyze mortality rates in levels and consider there to have been a decrease (increase) in inequality if the mortality rate in poor counties decreased (increased) more strongly in absolute

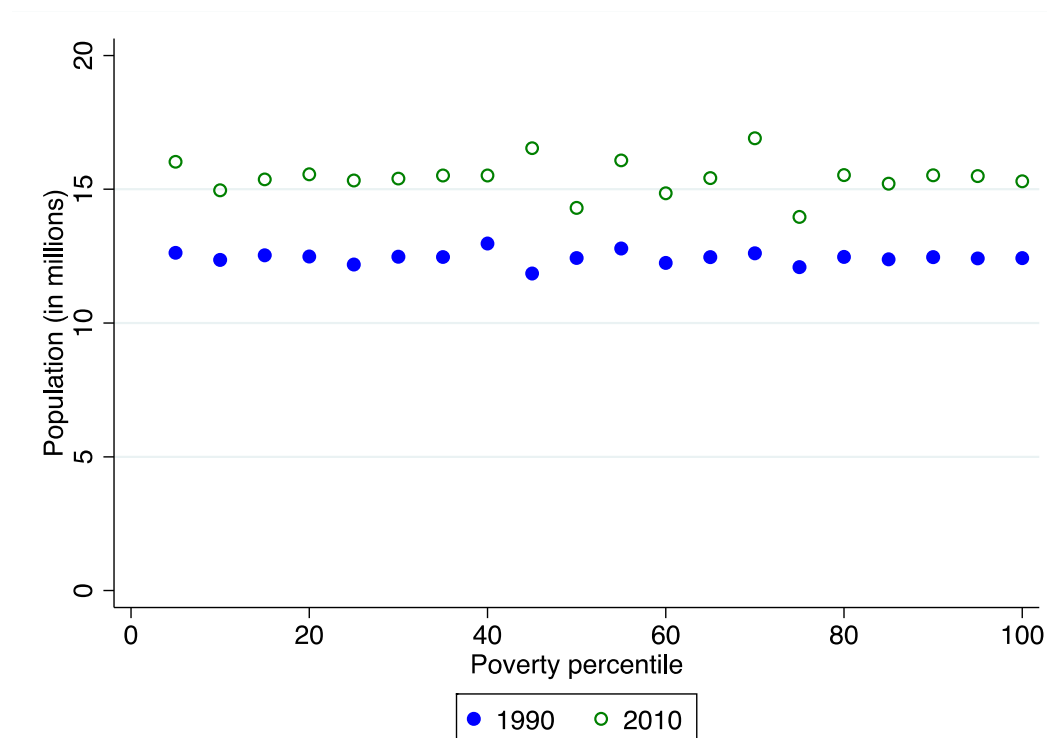
terms than the mortality rate in rich counties. We think that absolute changes are more relevant than relative changes in our context as we think one should care most about how many people die (i.e. weighting poor and rich deaths the same), regardless of the levels of mortality in each group. Consider the following example: Initially the death rate is 10 out of 100 among the poor and 1 out of 100 among the rich. Now suppose that the death rate increases by 9 out of 100 among the poor and by 1 out of 100 among the rich. If we only cared about relative changes, we would conclude that mortality increased by 90% among the poor but by 100% among the rich, suggesting that mortality worsened more for the rich than for the poor. If we were to think instead in terms of absolute changes, we would acknowledge the fact that the death toll increased much more for the poor than for the rich, a change that is then interpreted as an increase in inequality.

### ***Geographic distribution of poverty rates***

Fig. S7 shows the geographic distribution of county poverty rates across the U.S. in 1990. Most of the counties with the highest poverty rates are located in the South and Southwest. There are also some poor counties in the Midwest, in particular in South Dakota, and in Alaska (not shown in the map). The richest counties (those with the lowest poverty rates), on the other hand, are predominantly located in the North, with clusters in the Northeast. Fig. S8 shows an analogous map for 2010. Taken together, these figures show that the geographic distribution of rich and poor counties remained fairly stable between 1990 and 2010. It is less surprisingly then that, for the time period that we study, readjusting county groups to account for changes in the ranking of counties (as well as changes in the population) or following fixed sets of poor and rich counties over time provides similar results.

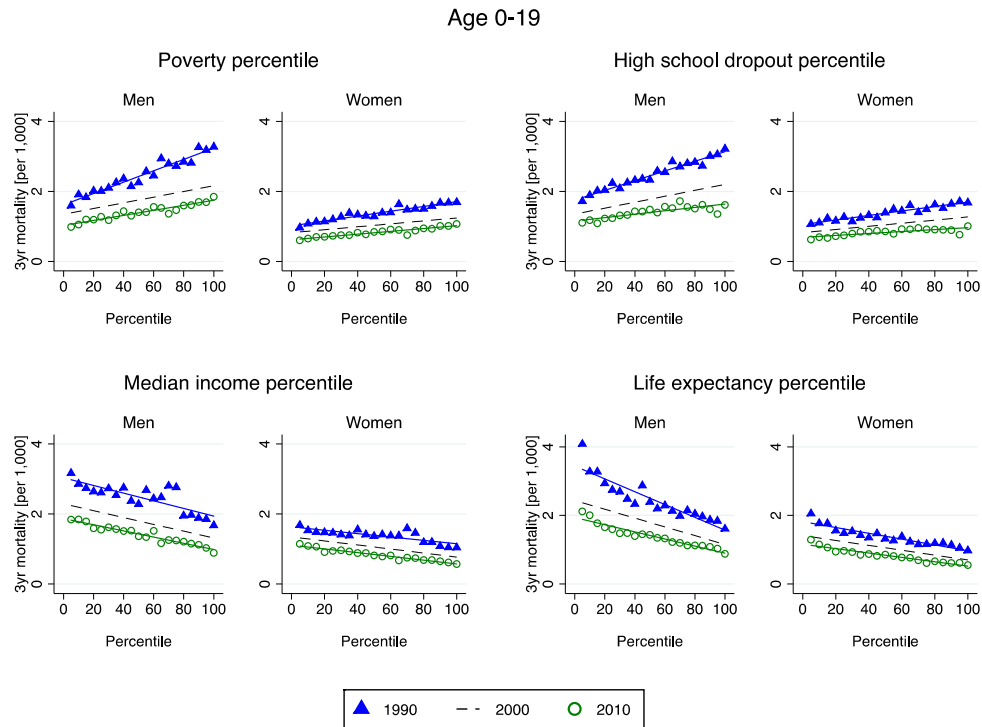
## Supplementary Figures

Figure S1: Population of county groups ordered by poverty rate, in 1990 and 2010



Notes: Poverty percentiles are constructed by ranking counties by their poverty level and dividing them into 5% bins of the overall population. Since counties are not exactly divisible into population shares, counties at the margin overlap the bins, making one group too large and the next group too small. In order to smooth the size of county groups we divide the five largest counties in our sample (Los Angeles CA, Cook County IL, Harris TX, Maricopa AZ, and Riverside County CA) into three smaller groups each of identical size and with the identical mortality rate. Overall, the variation in county group size is relatively small and it is not systematically related to county-level poverty.

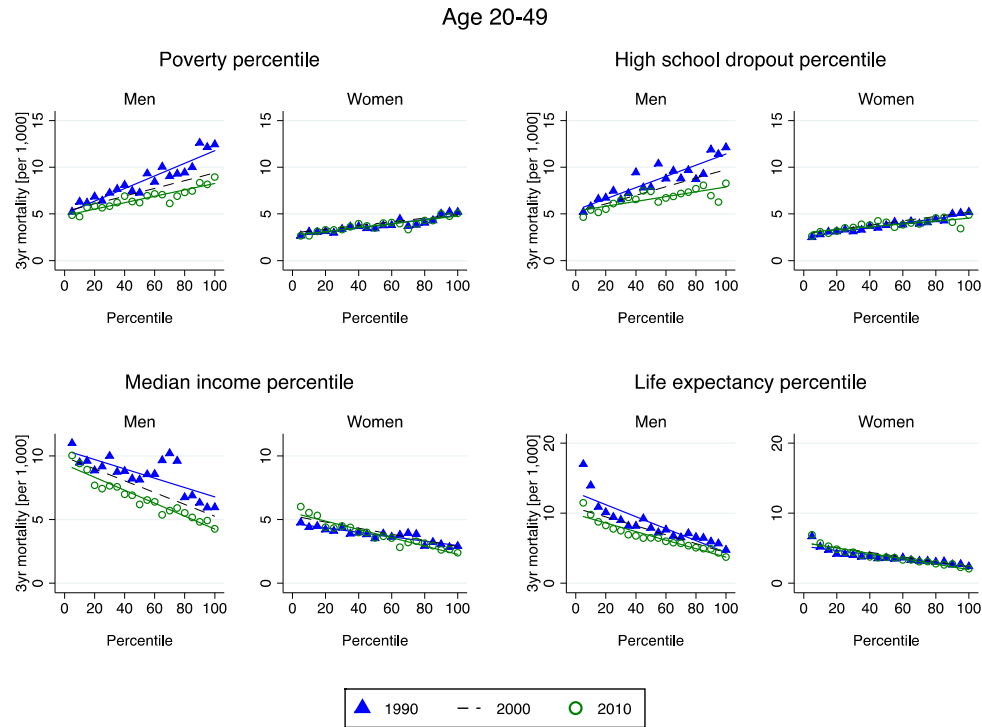
Figure S2: 3-year mortality rates ranked using alternative county characteristics, age 0-19



Notes: 3-year mortality rates are constructed for county groups that each represent about 5% of the overall population in the respective year. Counties are ranked by their poverty level in the upper left panel, by high school dropout rate in the upper right, by median income in the lower left, and by average life expectancy in the lower right panel (using county-level life expectancy estimates provided by (38)). Straight lines provide linear fits. This figure shows that the patterns are similar when we order counties using mean education, median income, or average life expectancy.

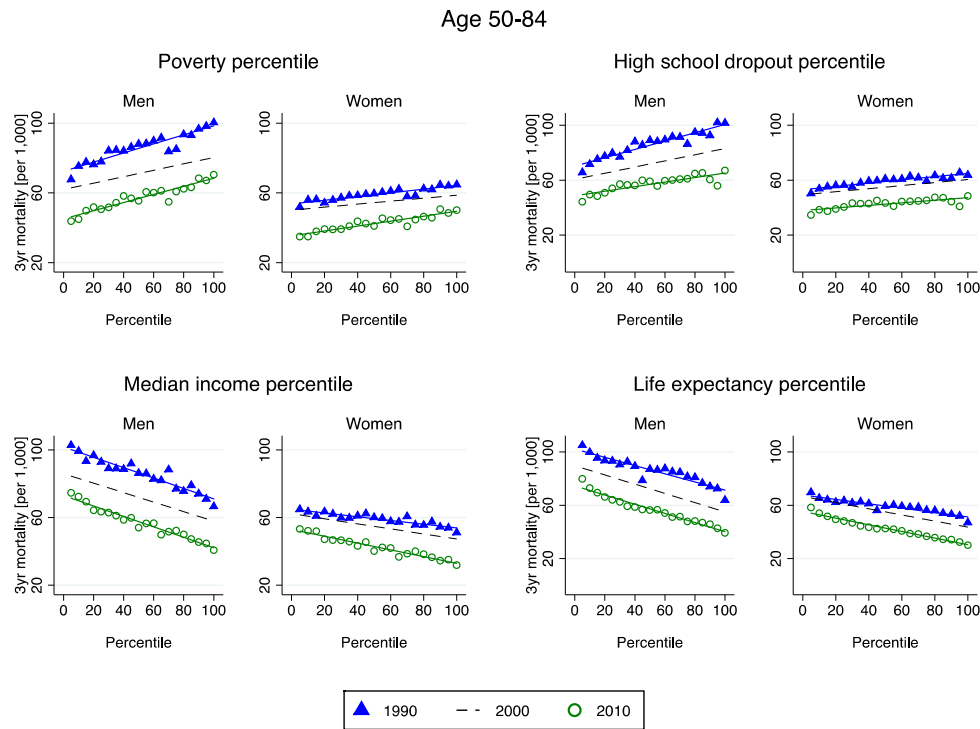


Figure S3: 3-yr mortality rates ranked using alternative county characteristics, age 20-49



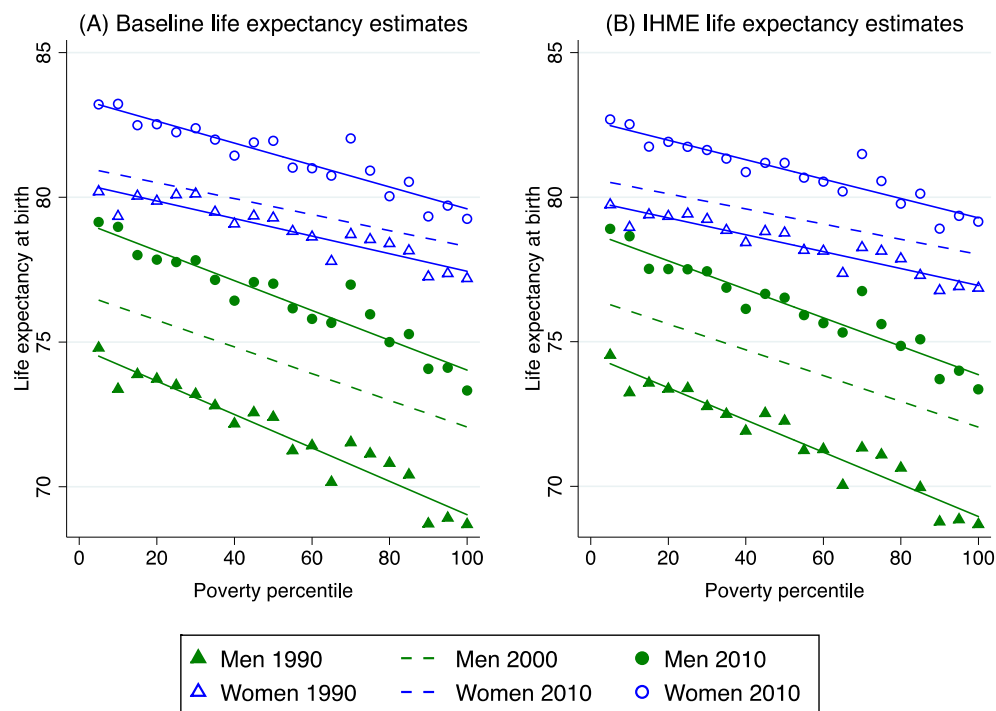
Notes: For notes see Figure S2.

Figure S4: 3-year mortality rates ranked using alternative county characteristics, age 50-84



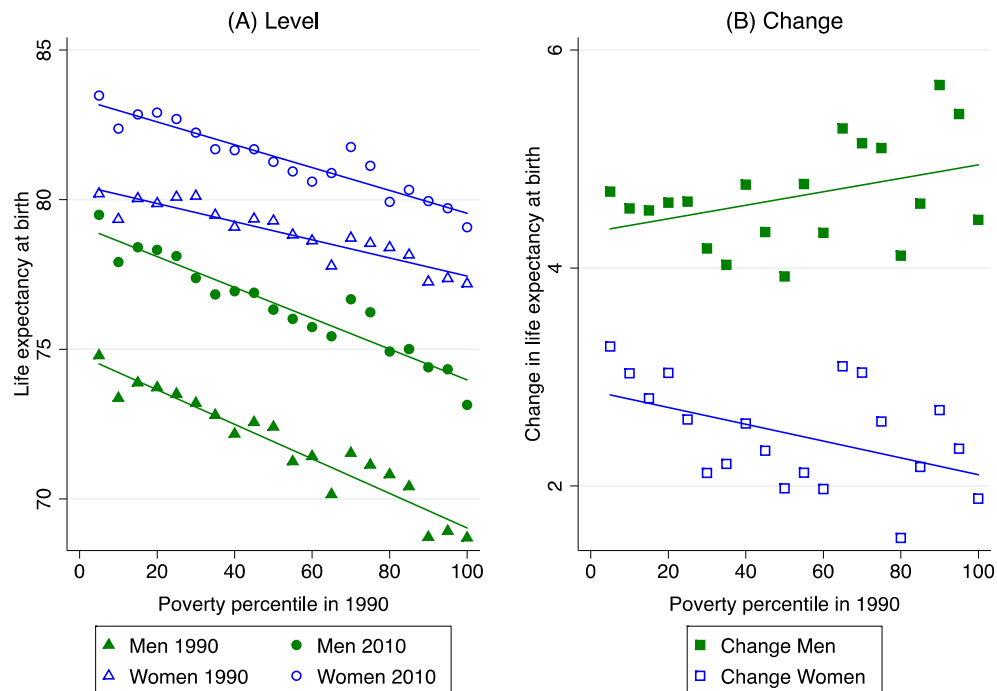
Notes: For notes see Figure S2.

Figure S5: Life expectancy at birth across poverty percentiles, gender, and years, using life expectancy estimates provided by the Institute for Health Metrics and Evaluation (IHME)



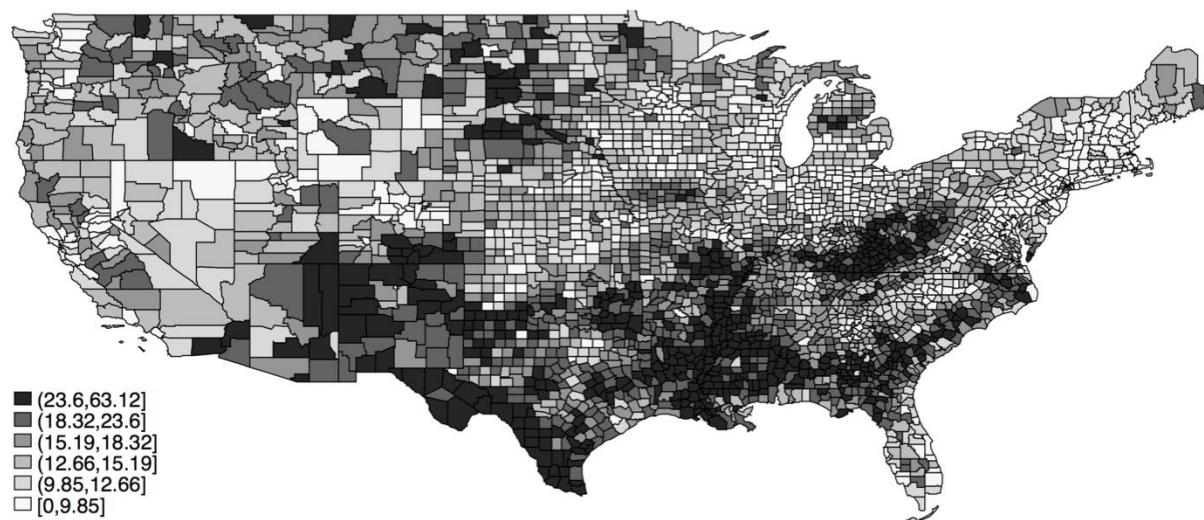
Notes: (A) shows Fig. 1 (A), which is based on life expectancy estimates constructed using death and population counts at the level of county groups. (B) replicates the same figure as (A) using county-level life expectancy estimates from the IHME, which we aggregated to the level of county groups. The IHME estimates use county-specific socio-economic characteristics to increase the precision of county-specific life expectancy (Wang 2013). Figures (A) and (B) are very similar, suggesting that the IHME procedure is unbiased at the level of county groups.

Figure S6: Male 3-year mortality rates by poverty percentile across age groups, with county groups fixed in 1990 and held constant in 2010



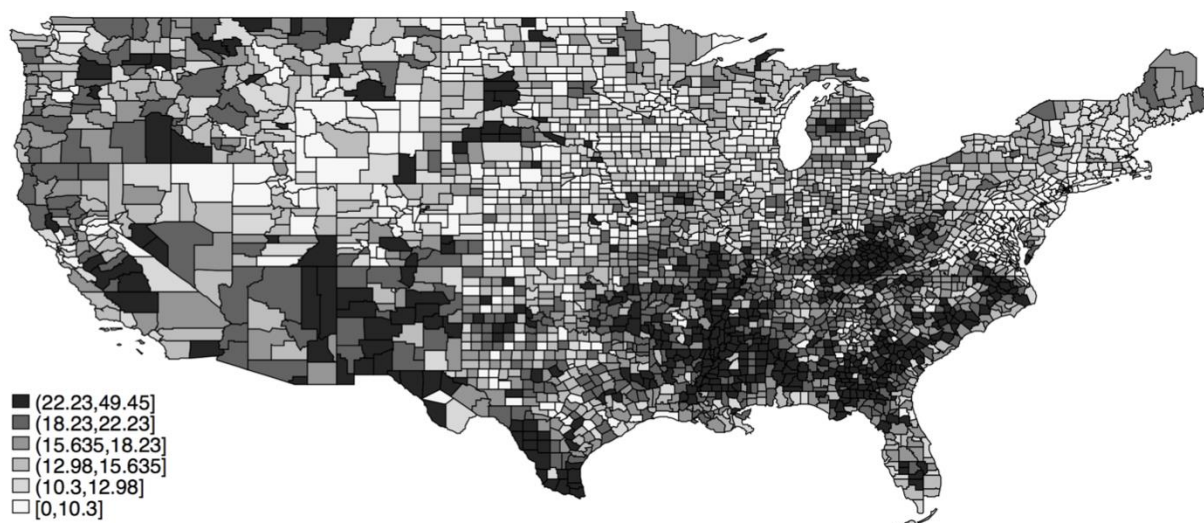
Notes: Poverty percentiles are constructed by ranking counties by their poverty level in 1990 and dividing them into 5% shares of the overall population in 1990. These county groups assigned in 1990 are then followed up to 2010. The fitted regression line in (B) has a slope of 0.0062 ( $p=0.092$ ) for men, and a slope of -0.0077 ( $p=0.035$ ) for women. Overall, these results look very similar to those presented in Fig. 1, indicating that our findings are robust to keeping the county groups assigned in 1990 fixed instead of reordering them over time. The same is true for the age-specific mortality trends shown in Figures 2 and 3.

Figure S7: County poverty rates in 1990.



Notes: Poverty rates are obtained from the 1990 US Census.

Figure S8: County poverty rates in 2010.



Notes: Poverty rates are obtained from the 2008-2012 American Community Survey.

## Supplementary Tables

Table S1: Population and economic characteristics of county groups ordered by poverty rate, in 1990 and 2010.

Poverty percentile	Population (in millions)		Poverty rate		Median income (constant 1999 USD)		Income per capita (constant 1999 USD)	
	1990	2010	1990	2010	1990	2010	1990	2010
5	12.62	16.02	3.75	5.58	62,445	62,752	27,087	28,730
10	12.36	14.96	5.36	7.24	53,921	57,173	23,470	27,428
15	12.53	15.37	6.43	8.65	52,007	49,675	23,828	24,526
20	12.48	15.56	7.45	9.94	50,307	47,581	22,063	22,939
25	12.19	15.33	8.28	10.76	46,824	45,207	21,150	22,851
30	12.48	15.40	9.28	11.67	40,949	44,684	19,637	21,710
35	12.47	15.51	10.13	12.28	39,803	41,689	18,319	21,287
40	12.97	15.51	10.76	13.14	40,474	38,611	18,842	20,298
45	11.85	16.53	11.37	13.94	38,882	39,043	18,191	19,995
50	12.43	14.30	12.07	14.50	36,703	37,943	17,247	19,372
55	12.79	16.08	12.81	15.37	37,739	36,146	18,011	18,033
60	12.24	14.85	13.47	16.07	35,713	35,879	17,685	18,641
65	12.46	15.42	14.12	16.55	37,901	36,187	18,138	19,587
70	12.61	16.91	14.84	17.08	38,603	37,975	18,100	19,497
75	12.09	13.96	15.38	17.48	37,444	36,237	17,557	20,874
80	12.47	15.53	16.51	17.98	32,681	34,839	16,185	18,774
85	12.38	15.21	18.07	18.88	31,923	32,225	15,700	17,375
90	12.46	15.52	20.04	20.24	32,635	30,394	17,475	16,240
95	12.42	15.49	22.24	22.91	29,048	29,595	13,951	15,428
100	12.42	15.30	30.47	28.30	23,595	25,404	11,386	13,383

Notes: Median and per capita income are adjusted for inflation and reported in constant 1999 dollars. Median income refers to counties' median income averaged across counties in each county group, weighted by counties' population size.

Table S2: Life expectancy at birth of county groups ordered by poverty rate, in 1990 and 2010

Poverty Percentile	Life expectancy at birth							
	Men				Women			
	1990		2010		1990		2010	
	LE at birth	std. err.	LE at birth	std. err.	LE at birth	std. err.	LE at birth	std. err.
5	74.79	0.061	79.14	0.053	80.20	0.057	83.21	0.048
10	73.37	0.063	78.98	0.055	79.34	0.060	83.23	0.050
15	73.88	0.062	78.00	0.054	80.04	0.058	82.49	0.049
20	73.72	0.063	77.85	0.054	79.87	0.060	82.52	0.049
25	73.50	0.064	77.76	0.055	80.09	0.061	82.25	0.050
30	73.20	0.064	77.82	0.054	80.12	0.059	82.39	0.050
35	72.80	0.064	77.15	0.054	79.49	0.061	82.00	0.050
40	72.17	0.063	76.43	0.055	79.08	0.059	81.44	0.050
45	72.56	0.065	77.07	0.053	79.36	0.062	81.90	0.049
50	72.41	0.064	77.01	0.057	79.29	0.060	81.95	0.053
55	71.25	0.065	76.17	0.053	78.82	0.061	81.03	0.049
60	71.42	0.065	75.80	0.057	78.63	0.062	81.00	0.053
65	70.15	0.067	75.66	0.056	77.79	0.063	80.75	0.052
70	71.53	0.066	76.98	0.054	78.72	0.062	82.03	0.049
75	71.14	0.067	75.96	0.058	78.54	0.064	80.92	0.054
80	70.81	0.066	75.00	0.056	78.40	0.062	80.04	0.052
85	70.41	0.067	75.27	0.056	78.15	0.063	80.54	0.052
90	68.72	0.068	74.07	0.055	77.25	0.064	79.34	0.052
95	68.92	0.069	74.11	0.057	77.37	0.064	79.71	0.053
100	68.70	0.069	73.32	0.058	77.19	0.065	79.26	0.054

Notes: Explanations regarding the construction of life expectancy at birth and its standard errors can be found above in the first part of the Supplementary Materials.

Table S3: Male 3-year mortality of bottom and top poverty county group and slope of fitted regression line, 1990 vs. 2010

Age group	Mortality rate (per 1,000) in 5% of the population living in								Slope of fitted regression line		
	counties with lowest poverty rate				counties with highest poverty rate						
	1990		2010		1990		2010				
	rate	std. err.	rate	std. err.	rate	std. err.	rate	std. err.	1990	2010	p-value of difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<1	9.77	0.34	5.53	0.24	18.28	0.46	9.79	0.29	0.083	0.036	<0.001
1-4	0.80	0.05	0.43	0.03	1.62	0.06	0.84	0.04	0.008	0.003	<0.001
5-9	0.50	0.03	0.26	0.02	1.01	0.04	0.50	0.03	0.004	0.002	<0.001
10-14	0.85	0.04	0.44	0.03	1.72	0.06	0.90	0.04	0.009	0.004	<0.001
15-19	2.65	0.08	1.92	0.06	5.83	0.10	3.10	0.07	0.031	0.010	<0.001
20-24	3.14	0.08	4.09	0.10	7.24	0.12	4.47	0.08	0.034	0.005	<0.001
25-29	3.43	0.08	3.45	0.09	9.00	0.14	5.59	0.10	0.051	0.018	<0.001
30-34	4.09	0.08	3.29	0.08	10.88	0.15	6.58	0.12	0.065	0.027	<0.001
35-39	5.29	0.10	3.62	0.08	13.22	0.18	8.44	0.14	0.080	0.038	<0.001
40-44	6.52	0.11	5.13	0.09	16.64	0.21	11.89	0.16	0.094	0.056	<0.001
45-49	9.80	0.15	8.19	0.11	22.62	0.27	19.14	0.20	0.120	0.095	0.035
50-54	15.88	0.22	12.72	0.14	32.39	0.35	28.71	0.24	0.151	0.141	0.499
55-59	27.63	0.31	19.57	0.19	49.91	0.45	40.74	0.30	0.196	0.187	0.602
60-64	47.54	0.43	28.83	0.26	71.55	0.53	54.33	0.38	0.217	0.224	0.726
65-69	75.56	0.58	45.64	0.38	101.69	0.65	76.22	0.51	0.229	0.268	0.192
70-74	122.06	0.86	75.04	0.59	148.19	0.88	107.30	0.69	0.240	0.296	0.173
75-79	187.42	1.28	126.97	0.86	207.20	1.15	159.64	0.96	0.195	0.320	0.025
80-84	299.77	2.04	218.65	1.24	296.49	1.67	240.84	1.36	0.060	0.242	0.022
>84	497.92	2.81	437.79	1.68	458.15	2.28	422.64	1.82	-0.222	-0.036	0.084

Notes: Columns (1) to (8) show mortality rates for the bottom and top ventile of county groups, as plotted in Figure 2, along with standard errors. Columns (9) and (10) report the slope of the fitted regression lines for 1990 and 2010 in Figure 2, and (11) reports the p-value of the difference between the two slopes.



Table S4: Female 3-year mortality of bottom and top poverty county group and slope of fitted regression line, 1990 vs. 2010

Age group	Mortality rate (per 1,000) in 5% of the population living in								Slope of fitted regression line		
	counties with lowest poverty rate				counties with highest poverty rate						
	1990		2010		1990		2010				
	rate	std. err.	rate	std. err.	rate	std. err.	rate	std. err.	1990	2010	p-value of difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<1	8.01	0.32	4.86	0.23	15.15	0.42	8.32	0.28	0.071	0.032	<0.001
1-4	0.60	0.04	0.38	0.03	1.19	0.05	0.73	0.04	0.005	0.003	<0.001
5-9	0.32	0.03	0.20	0.02	0.70	0.04	0.40	0.03	0.003	0.001	0.003
10-14	0.45	0.03	0.27	0.02	0.88	0.04	0.54	0.03	0.003	0.002	0.049
15-19	1.11	0.05	0.80	0.04	1.68	0.06	1.05	0.04	0.006	0.002	<0.001
20-24	1.10	0.05	1.46	0.06	2.17	0.07	1.48	0.05	0.009	0.001	<0.001
25-29	1.36	0.05	1.39	0.05	2.92	0.08	2.47	0.07	0.014	0.008	0.004
30-34	1.66	0.05	1.62	0.06	3.86	0.09	3.44	0.08	0.021	0.017	0.168
35-39	2.41	0.07	1.98	0.06	5.49	0.11	5.03	0.10	0.028	0.025	0.380
40-44	3.98	0.09	3.11	0.07	7.77	0.14	7.71	0.13	0.034	0.039	0.384
45-49	6.09	0.12	5.04	0.08	11.73	0.19	11.66	0.15	0.046	0.059	0.041
50-54	10.44	0.18	7.98	0.11	17.49	0.25	16.66	0.18	0.061	0.082	0.008
55-59	17.48	0.25	12.04	0.15	25.89	0.30	22.89	0.22	0.077	0.098	0.027
60-64	28.77	0.32	18.86	0.20	39.60	0.37	32.95	0.28	0.097	0.124	0.038
65-69	46.09	0.42	32.05	0.31	57.33	0.45	48.41	0.38	0.105	0.147	0.019
70-74	76.81	0.61	54.43	0.47	83.23	0.58	71.33	0.52	0.080	0.160	0.006
75-79	121.92	0.86	94.70	0.66	124.08	0.75	109.58	0.70	0.043	0.183	<0.001
80-84	202.58	1.26	165.78	0.91	196.34	1.08	177.83	0.96	0.015	0.184	0.004
>84	411.51	1.62	386.39	1.14	384.78	1.46	376.08	1.21	-0.134	0.044	0.046

Notes: Columns (1) to (8) show mortality rates for the bottom and top ventile of county groups, as plotted in Figure 3, along with standard errors. Columns (9) and (10) report the slope of the fitted regression lines for 1990 and 2010 in Figure 3, and (11) reports the p-value of the difference between the two slopes.